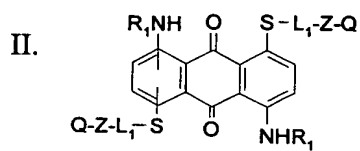
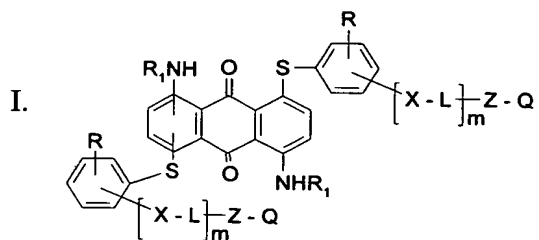


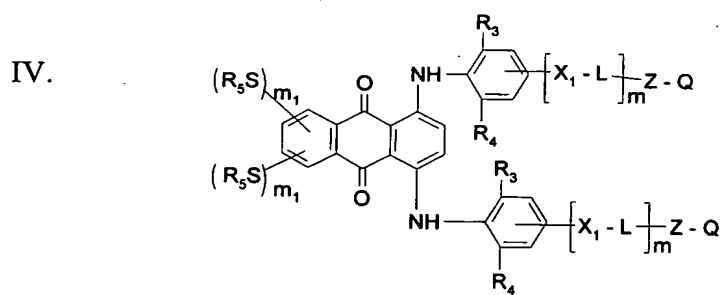
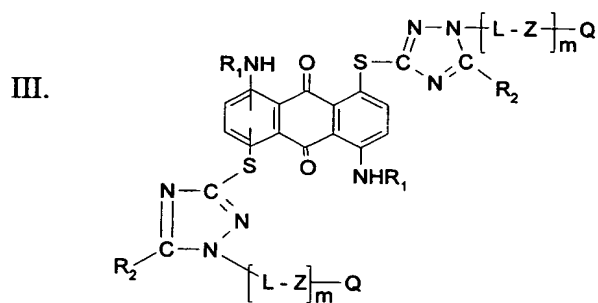
# CLAIMS

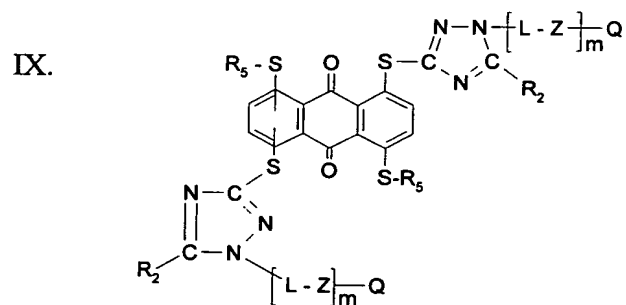
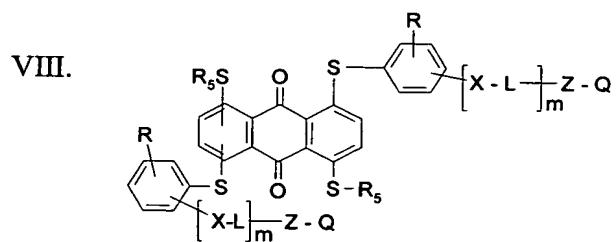
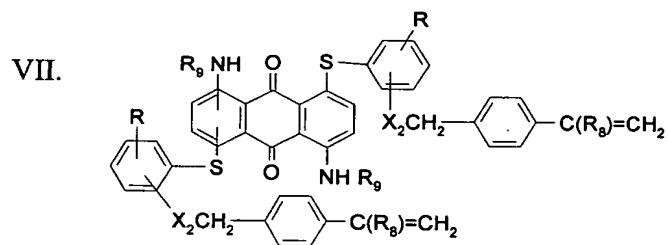
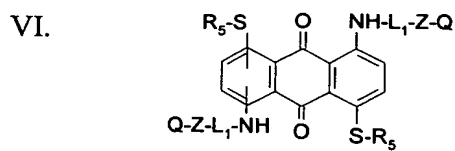
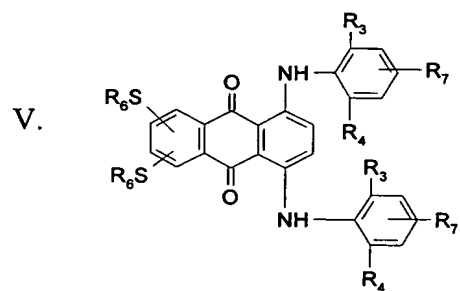
We claim:

1. Anthraquinone dye compounds having the formulae:

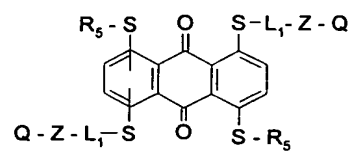


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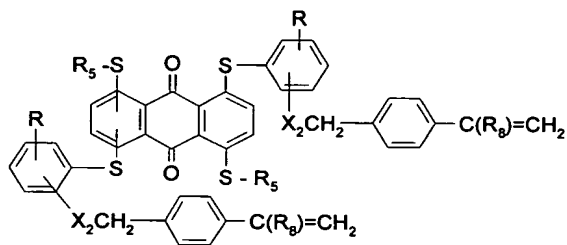




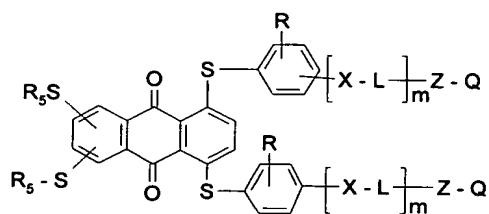
X.



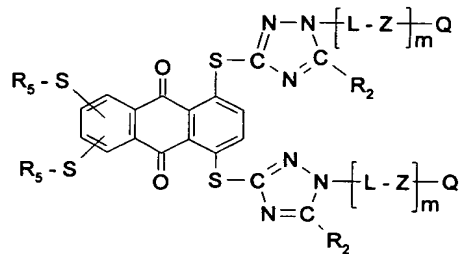
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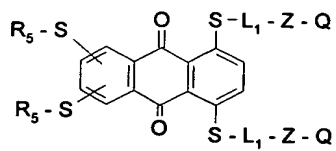
XII.



XIII.

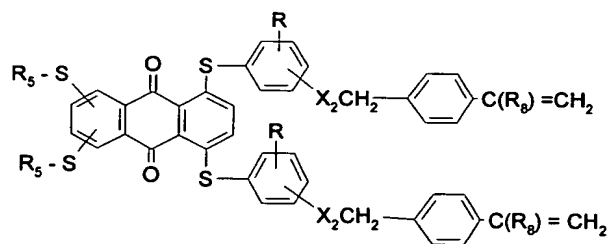


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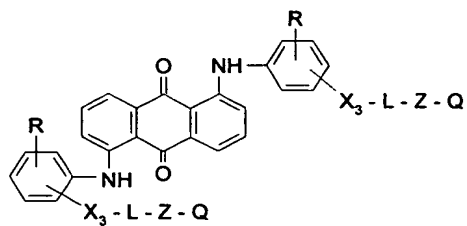


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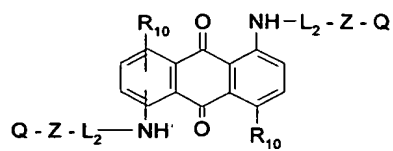
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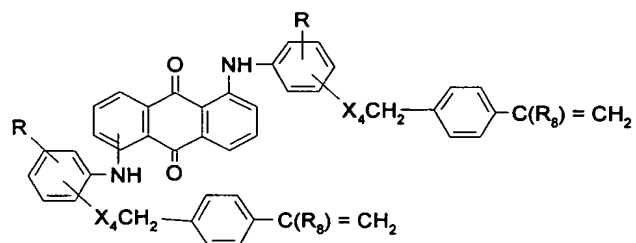
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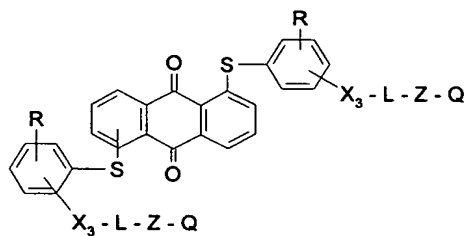
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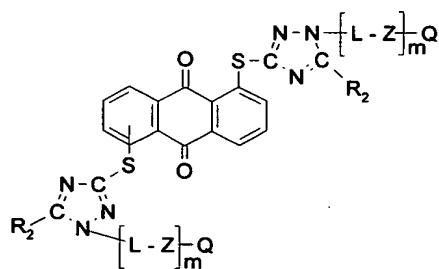
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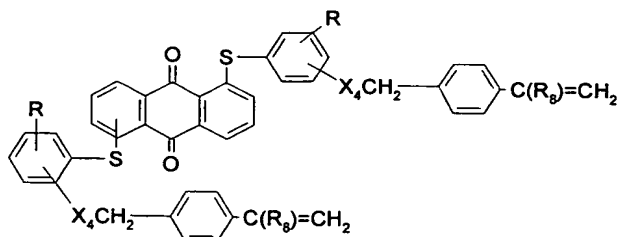
XIX.



XX.



XXI.



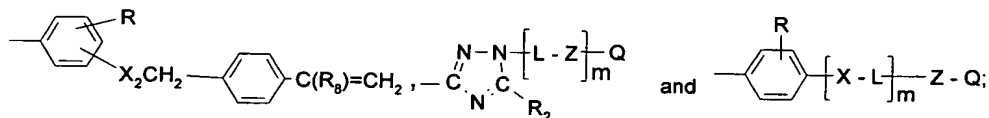
wherein:

R is selected from hydrogen or 1-3 groups selected from C<sub>1</sub> - C<sub>6</sub>-alkyl, C<sub>1</sub> - C<sub>6</sub>-alkoxy and halogen;

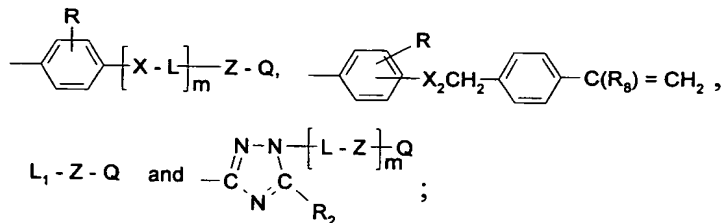
5 R<sub>1</sub> is selected from C<sub>1</sub> - C<sub>6</sub>-alkyl, substituted C<sub>1</sub> - C<sub>6</sub>-alkyl, C<sub>3</sub> - C<sub>8</sub>-alkenyl, C<sub>3</sub> - C<sub>8</sub>-cycloalkyl, aryl and -L<sub>1</sub>-Z-Q; R<sub>2</sub> = selected from hydrogen, C<sub>1</sub> - C<sub>6</sub>-alkyl, substituted C<sub>1</sub> - C<sub>6</sub>-alkyl, C<sub>3</sub> - C<sub>8</sub>-cycloalkyl and aryl;

R<sub>3</sub> and R<sub>4</sub> are independently selected from C<sub>1</sub> - C<sub>6</sub>-alkyl and bromine;

10 R<sub>5</sub> is selected from C<sub>1</sub> - C<sub>6</sub>-alkyl, substituted C<sub>1</sub> - C<sub>6</sub> alkyl, C<sub>3</sub> - C<sub>8</sub>-cycloalkyl, aryl, heteroaryl, -L<sub>1</sub>-Z-Q,



R<sub>6</sub> is selected from



15 R<sub>7</sub> is selected from hydrogen, substituted or unsubstituted C<sub>1</sub> - C<sub>6</sub>-alkyl, C<sub>1</sub> - C<sub>6</sub>-alkoxy, halogen, hydroxy, substituted or unsubstituted C<sub>1</sub> - C<sub>6</sub>-alkylthio, sulfamoyl and substituted sulfamoyl;

R<sub>8</sub> is selected from hydrogen and C<sub>1</sub> - C<sub>6</sub>-alkyl;

R<sub>9</sub> is selected from the groups represented by R<sub>1</sub> and -L - Z - Q;

R<sub>10</sub> is selected from hydrogen and halogen;

X is a covalent bond or a divalent linking group selected from -O-, -S-, -SO<sub>2</sub>-, -CO<sub>2</sub>-, -CON(Y)- and -SO<sub>2</sub>N(Y)-, wherein Y is selected from hydrogen, C<sub>1</sub>-C<sub>6</sub>-alkyl, substituted C<sub>1</sub>-C<sub>6</sub>-alkyl, C<sub>3</sub>-C<sub>8</sub>-cycloalkyl, C<sub>3</sub>-C<sub>8</sub>-alkenyl, aryl and -L-Z- Q;

X<sub>1</sub> is selected from -O-, -S-, -SO<sub>2</sub>- and -SO<sub>2</sub>N(Y)-;

X<sub>2</sub> is selected from -CO<sub>2</sub>- and -SO<sub>2</sub>N(Y<sub>1</sub>), wherein Y<sub>1</sub> is a group selected from hydrogen, C<sub>1</sub>-C<sub>6</sub>-alkyl, substituted C<sub>1</sub>-C<sub>6</sub>-alkyl, C<sub>3</sub>-C<sub>8</sub>-alkenyl, C<sub>3</sub>-C<sub>8</sub>-cycloalkyl, aryl, heteroaryl and -CH<sub>2</sub>-p-C<sub>6</sub>H<sub>4</sub>-C(R<sub>8</sub>)=CH<sub>2</sub>;

X<sub>3</sub> is selected from -CO<sub>2</sub>-, -SO<sub>2</sub>N(Y)-;

X<sub>4</sub> is selected from -CO<sub>2</sub>-, -O- and -SO<sub>2</sub>N(Y<sub>1</sub>)-;

L is a divalent linking group selected from C<sub>1</sub>-C<sub>8</sub>-alkylene, C<sub>1</sub>-C<sub>6</sub>-alkylene-arylene, arylene, C<sub>1</sub>-C<sub>6</sub>-alkylene-arylene -C<sub>1</sub>-C<sub>6</sub>-alkylene, C<sub>3</sub>-C<sub>8</sub>-cycloalkylene, C<sub>1</sub>-C<sub>6</sub>-alkylene -C<sub>3</sub>-C<sub>8</sub>-cycloalkylene -C<sub>1</sub>-C<sub>6</sub>-alkylene, C<sub>1</sub>-C<sub>6</sub>-alkylene - Z<sub>1</sub>-arylene -Z<sub>1</sub>-C<sub>1</sub>-C<sub>6</sub>-alkylene and C<sub>2</sub>-C<sub>6</sub>-alkylene-[-Z<sub>1</sub>-C<sub>2</sub>-C<sub>6</sub>-alkylene-]<sub>n</sub>- wherein Z<sub>1</sub> is selected from -O-, -S- and -SO<sub>2</sub>- and n is 1-3;

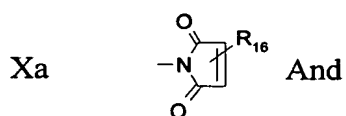
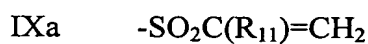
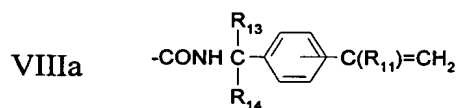
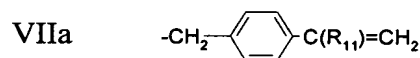
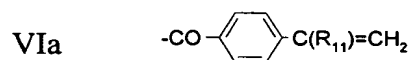
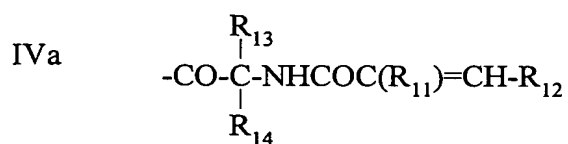
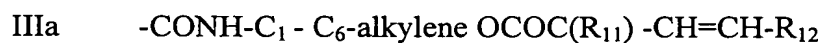
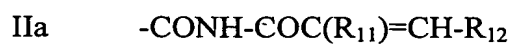
L<sub>1</sub> is a divalent linking group selected from C<sub>2</sub> - C<sub>6</sub>-alkylene, C<sub>1</sub>-C<sub>6</sub>-alkylene-C<sub>3</sub>-C<sub>8</sub>-cycloalkylene-C<sub>1</sub>-C<sub>6</sub>-alkylene, C<sub>1</sub>-C<sub>6</sub>-alkylene-arylene, C<sub>3</sub>-C<sub>8</sub>-cycloalkylene, and C<sub>2</sub>-C<sub>6</sub>-alkylene-[-Z<sub>1</sub>-C<sub>2</sub>-C<sub>6</sub>-alkylene-]<sub>n</sub>;

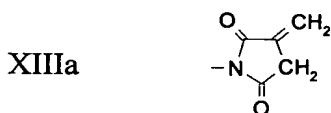
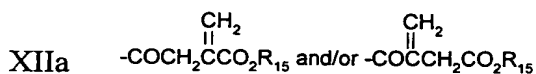
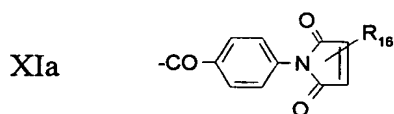
L<sub>2</sub> is selected from C<sub>2</sub>-C<sub>6</sub>-alkylene, C<sub>1</sub>-C<sub>6</sub>-alkylene- arylene-C<sub>1</sub>-C<sub>6</sub> alkylene and C<sub>1</sub>-C<sub>6</sub>-alkylene-C<sub>3</sub>-C<sub>8</sub>-cycloalkylene-C<sub>1</sub>-C<sub>6</sub>-alkylene;

Z is a divalent group selected from -O-, -S-, -NH-, -N(C<sub>1</sub>-C<sub>6</sub>-alkyl)-, -N(C<sub>3</sub>-C<sub>8</sub> alkenyl)-, -N(C<sub>3</sub>-C<sub>8</sub> cycloalkyl)-, -N(aryl)-, -N(SO<sub>2</sub>C<sub>1</sub>-C<sub>6</sub>-alkyl) and -N(SO<sub>2</sub> aryl)-, provided that when Q is a photopolymerizable optionally substituted maleimide radical, Z represents a covalent bond; Q is an ethylenically-unsaturated, photosensitive polymerizable group; and

m and m<sub>1</sub> each is 0 or 1.

2. Anthraquinone compounds according to Claim 1 wherein the ethylenically-unsaturated, photosensitive copolymerizable groups represented by Q are selected from the following organic radicals:





wherein:

$\text{R}_{11}$  is selected from hydrogen and  $\text{C}_1\text{-C}_6\text{-alkyl}$ ;

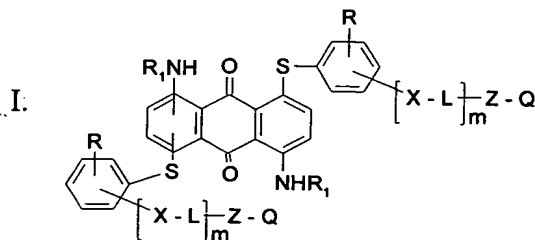
$\text{R}_{12}$  is selected from hydrogen;  $\text{C}_1\text{-C}_6\text{-alkyl}$ ; phenyl and phenyl substituted with one or more groups selected from  $\text{C}_1\text{-C}_6\text{-alkyl}$ ,  $\text{C}_1\text{-C}_6\text{-alkoxy}$ ,  $-\text{N}(\text{C}_1\text{-C}_6\text{-alkyl})$ ,  
5 nitro, cyano,  $\text{C}_1\text{-C}_6\text{-alkoxycarbonyl}$ ,  $\text{C}_1\text{-C}_6\text{-alkanoyloxy}$  and halogen; 1- and 2-naphthyl which may be substituted with  $\text{C}_1\text{-C}_6\text{-alkyl}$  or  $\text{C}_1\text{-C}_6\text{-alkoxy}$ ; 2- and 3-thienyl which may be substituted with  $\text{C}_1\text{-C}_6\text{-alkyl}$  or halogen; 2- or 3-furyl which may be substituted with  $\text{C}_1\text{-C}_6\text{-alkyl}$ ;

$\text{R}_{13}$  and  $\text{R}_{14}$  are selected from hydrogen,  $\text{C}_1\text{-C}_6\text{-alkyl}$ , substituted  $\text{C}_1\text{-C}_6\text{-alkyl}$ , aryl or may be combined to represent a  $-\text{[CH}_2\text{-]}_{3-5}\text{- radical}$ ;

$\text{R}_{15}$  is selected from hydrogen,  $\text{C}_1\text{-C}_6\text{-alkyl}$ , substituted  $\text{C}_1\text{-C}_6\text{-alkyl}$ ,  $\text{C}_3\text{-C}_8\text{-alkenyl}$ ,  $\text{C}_3\text{-C}_8\text{-cycloalkyl}$  and aryl;

$\text{R}_{16}$  is selected from hydrogen,  $\text{C}_1\text{-C}_6\text{-alkyl}$  and aryl.

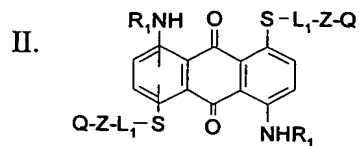
15 3. Anthraquinone compounds according to Claim 2 having the formula:



wherein Z is  $-\text{O}-$ .



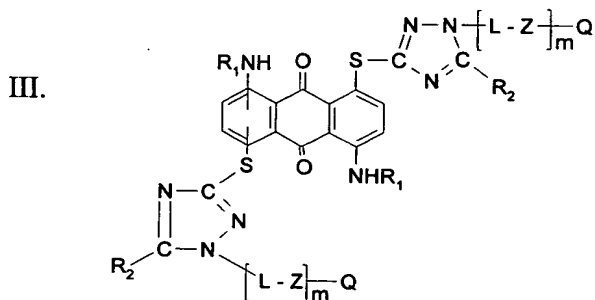
4. Anthraquinone compounds according to Claim 2 having the formula:



wherein Z is  $-O-$ .

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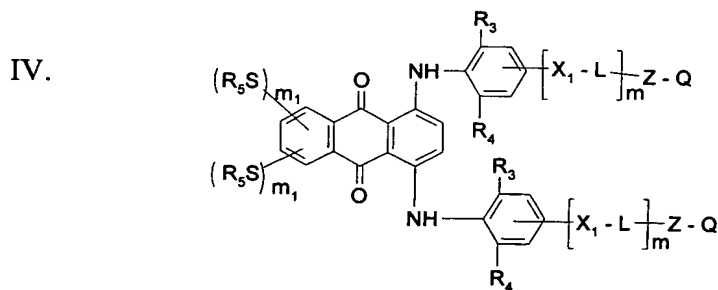
5. Anthraquinone compounds according to Claim 2 having the formula:



wherein Z is  $-O-$ .

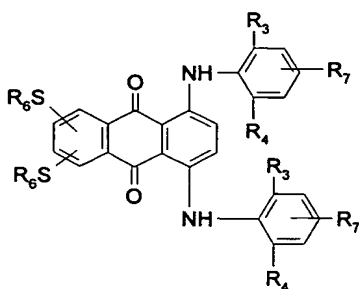
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6. Anthraquinone compounds according to Claim 2 having the formula:



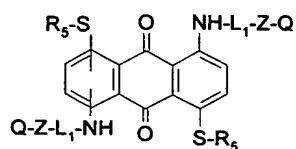
wherein Z is  $-O-$ .

- V.

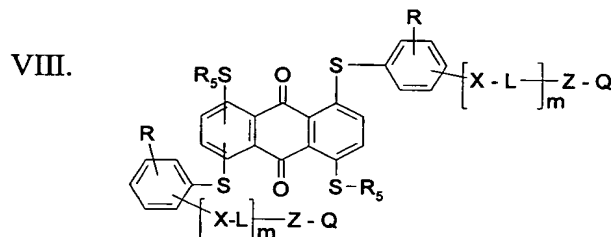


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- VI.

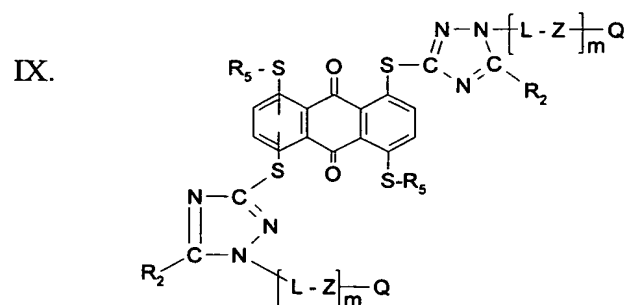


9. Anthraquinone compounds according to Claim 2 having the formula:



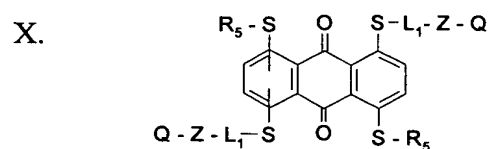
wherein Z is -O-.

10. Anthraquinone compounds according to Claim 2 having the formula:



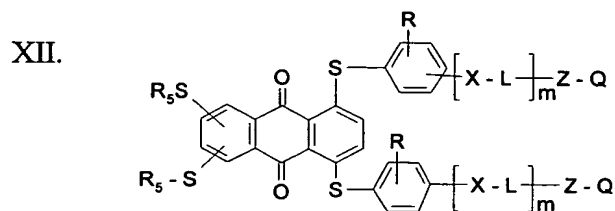
wherein Z is  $-O-$ .

- 5 11. Anthraquinone compounds according to Claim 2 having the formula:



wherein Z is  $-O-$ .

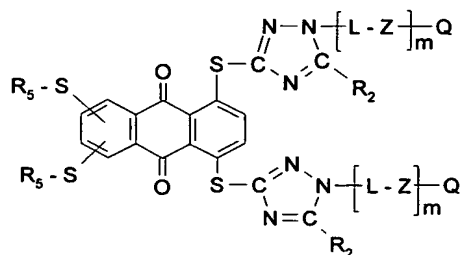
12. Anthraquinone compounds according to Claim 2 having the formula:



wherein Z is  $-O-$ .

13. Anthraquinone compounds according to Claim 2 having the formula:

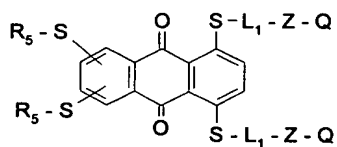
XIII.



wherein Z is -O-.

5 14. Anthraquinone compounds according to Claim 2 having the formula:

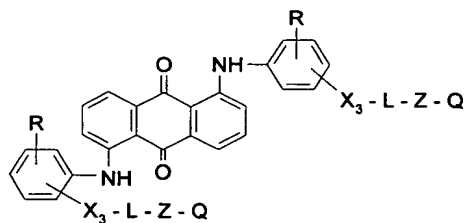
XIV.



wherein Z is -O-.

15. Anthraquinone compounds according to Claim 2 having the formula:

XVI.

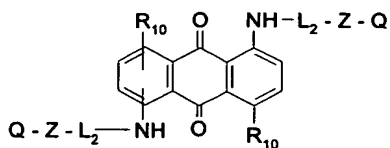


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wherein Z is -O-.

16. Anthraquinone compounds according to Claim 2 having the formula:

XVII.

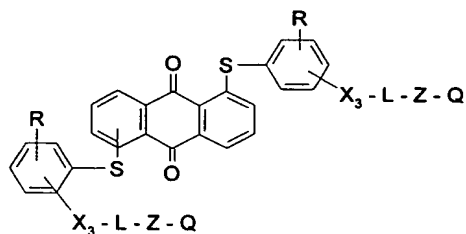


15

wherein Z is -O-.

17. Anthraquinone compounds according to Claim 2 having the formula:

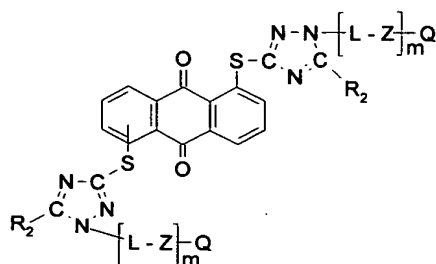
XIX.



wherein Z is  $-O-$ .

5 18. Anthraquinone compounds according to Claim 2 having the formula:

XX.



wherein Z is  $-O-$ .

10 19. Anthraquinone compounds according to Claim 2 wherein Q is organic radical Ia.

20. Anthraquinone compounds according to Claim 2 wherein Q is organic radical Ia wherein  $R_{11}$  is hydrogen or methyl and  $R_{12}$  is hydrogen.

15 21. Anthraquinone compounds according to Claim 2 wherein Q is organic radical VIIa.

22. Anthraquinone compounds according to Claim 2 wherein Q is organic radical VIIa wherein  $R_{11}$  is hydrogen.

23. Anthraquinone compounds according to Claim 2 wherein Q is organic radical VIIIa.
- 5 24. Anthraquinone compounds according to Claim 2 wherein Q is organic radical VIIIa wherein  $R_{11}$  is hydrogen or methyl and  $R_{13}$  and  $R_{14}$  are methyl. .
25. Anthraquinone compounds according to Claim 3 wherein X is  $-\text{CO}_2-$ , L is  $-\text{CH}_2\text{CH}_2-$ , and m is 1.
- 10 26. Anthraquinone compounds according to Claim 5 wherein L is  $-\text{CH}_2\text{CH}_2-$ , m is 1, and  $R_2$  is hydrogen.
- 15 27. Anthraquinone compounds according to Claim 8 wherein  $L_1$  is  $-\text{CH}_2\text{C}(\text{CH}_3)_2\text{CH}_2-$  and  $R_5$  is aryl.
28. Anthraquinone compounds according to Claim 9 wherein X is  $-\text{CO}_2-$ , L is  $-\text{CH}_2\text{CH}_2-$ , and m is 1.
- 20 29. Anthraquinone compounds according to Claim 10 wherein L is  $-\text{CH}_2\text{CH}_2-$ ,  $R_2$  is hydrogen and m is 1.
30. Anthraquinone compounds according to Claim 12 wherein X is  $-\text{CO}_2-$ , L is  $-\text{CH}_2\text{CH}_2-$ , and m is 1.
- 25 31. Anthraquinone compounds according to Claim 13 wherein L is  $-\text{CH}_2\text{CH}_2-$ ,  $R_2$  is hydrogen and m is 1.
- 30 32. Anthraquinone compounds according to Claim 15 wherein  $X_3$  is  $-\text{CO}_2-$ , L is  $-\text{CH}_2\text{CH}_2-$ , and R is hydrogen or bromine.

33. Anthraquinone compounds according to Claim 15 wherein  $X_3$  is  $-\text{CO}_2-$ , L is propylene, 1,4-cyclohexylenedimethylene or 2,2-dimethyltrimethylene, R is hydrogen, Z is  $-\text{O}-$ , and Q is an organic radical having the structure  $-\text{COC}(\text{R}_{11})=\text{CH}_2$  wherein  $\text{R}_{11}$  is hydrogen, methyl or ethyl.

5

34. Anthraquinone compounds according to Claim 15 wherein  $X_3$  is  $-\text{CO}_2-$ , L is propylene, 1,4-cyclohexylenedimethylene or 2,2-dimethyltrimethylene, R is hydrogen, Z is  $-\text{O}-$ , and Q is an organic radical having structure VIIIa wherein  $\text{R}_{11}$ ,  $\text{R}_{13}$  and  $\text{R}_{14}$  each is methyl.

10

35. Anthraquinone compounds according to Claim 16 wherein  $\text{L}_2$  is  $-\text{CH}_2\text{C}(\text{CH}_3)_2\text{CH}_2-$ , and  $\text{R}_{10}$  is hydrogen.

15

36. Anthraquinone compounds according to Claim 17 wherein  $X_3$  is  $-\text{CO}_2-$ , L is  $-\text{CH}_2\text{CH}_2-$ , and R is hydrogen.

20

37. Anthraquinone compounds according to Claim 17 wherein  $X_3$  is  $-\text{CO}_2-$ , L is propylene, 1,4-cyclohexylenedimethylene or 2,2-dimethyltrimethylene, R is hydrogen, Z is  $-\text{O}-$ , and Q is an organic radical having the structure  $-\text{COC}(\text{R}_{11})=\text{CH}_2$  wherein  $\text{R}_{11}$  is hydrogen, methyl or ethyl.

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38. Anthraquinone compounds according to Claim 17 wherein  $X_3$  is  $-\text{CO}_2-$ , L is propylene, 1,4-cyclohexylenedimethylene or 2,2-dimethyltrimethylene, R is hydrogen, Z is  $-\text{O}-$ , and Q is an organic radical having structure VIIIa wherein  $\text{R}_{11}$ ,  $\text{R}_{13}$  and  $\text{R}_{14}$  each is methyl.

39. Anthraquinone compounds according to Claim 18 wherein L is  $-\text{CH}_2\text{CH}_2-$ ,  $\text{R}_2$  is hydrogen, and m is 1.

40. Anthraquinone compounds according to Claim 6 wherein X is  $-\text{SO}_2\text{N}(\text{Y})-$ , L is  $\text{C}_2\text{-C}_6$  alkylene,  $\text{R}_3$  and  $\text{R}_4$  are methyl or ethyl, Y is hydrogen, m is 1 and  $m_1$  is 0.
- 5 41. Anthraquinone compounds according to Claim 6 wherein X is  $-\text{SO}_2\text{N}(\text{Y})-$ , L is  $\text{C}_2\text{-C}_6$  alkylene,  $\text{R}_3$  and  $\text{R}_4$  are methyl or ethyl, Y is hydrogen, m is 1 and  $m_1$  is 1.
- 10 42. Anthraquinone compounds according to Claim 1 having formula VII wherein  $\text{X}_2$  is  $-\text{CO}_2-$  and R and  $\text{R}_8$  are hydrogen.
43. Anthraquinone compounds according to Claim 1 having formula XI wherein  $\text{X}_2$  is  $-\text{CO}_2-$  and  $\text{R}_1$  and  $\text{R}_8$  are hydrogen.
- 15 44. Anthraquinone compounds according to Claim 1 having formula XVII wherein  $\text{X}_4$  is  $-\text{CO}_2-$  and R and  $\text{R}_8$  are hydrogen.
- 20 45. Anthraquinone compounds according to Claim 1 having formula XXI wherein  $\text{X}_4$  is  $-\text{CO}_2-$  and R and  $\text{R}_8$  are hydrogen.
46. Anthraquinone compounds according to Claim 1 having formula IV wherein  $\text{X}_1$  is  $-\text{O}-$ , Z is  $-\text{O}-$ , L is  $-\text{CH}_2\text{CH}_2-$ ,  $\text{R}_3$  and  $\text{R}_4$  are methyl or ethyl, m is 1 and  $m_1$  is 0.
- 25 47. A coating composition comprising (i) one or more polymerizable vinyl compounds, (ii) one or more of the dye compounds of Claim 1, and (iii) a photoinitiator.
- 30 48. A coating composition according to Claim 47 comprising (i) one or more polymerizable vinyl compounds, (ii) one or more of the dye compounds of Claim 2



present in a concentration of about 0.05 to 15 weight percent based on the weight of component (i), and (iii) a photoinitiator present in a concentration of about 1 to 15 weight percent based on the weight of the polymerizable vinyl compound(s) present in the coating composition.

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49. A coating composition according to Claim 48 wherein the polymerizable vinyl compounds comprise a solution of a polymeric, polymerizable vinyl compound selected from acrylated and methacrylated polyesters, acrylated and methacrylated polyethers, acrylated and methacrylated epoxy polymers, acrylated or methacrylated urethanes, and mixtures thereof, in a diluent selected from monomeric acrylate and methacrylate esters.

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50. A polymeric coating composition comprising a polymer of one or more acrylic acid esters, one or more methacrylic acid esters and/or other copolymerizable vinyl compounds, having copolymerized therein one or more of the dye compounds defined in Claim 1.

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51. A polymeric composition according to Claim 50 comprising a coating of an acrylic polymer of one or more acrylic acid esters, one or more methacrylic acid esters or a mixture thereof having copolymerized therein one or more of the dye compounds defined in Claim 2.

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52. A polymeric composition according to Claim 50 comprising a coating of an unsaturated polyester containing one or more maleate/fumarate residues; one or more monomers which contain one or more vinyl ether groups, one or more vinyl ester groups, or a combination thereof, and, optionally, one or more acrylic or methacrylic acid esters; or a mixture thereof having copolymerized therein one or more of the dye compounds defined in Claim 2.

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53. A polymeric coating according to Claim 51 containing from about 0.05 to 15.0 weight percent of the residue of one or more of the dye compounds of Claim 2 based on the weight of the coating.